INTERNATIONAL STANDARD

ISO 15663-2

First edition
2001-09-01

Petroleum and natural gas industries — Life-cycle costing —

Part 2: **Guidance on application of methodology and calculation methods**

Industries du pétrole et du gaz naturel — Estimation des coûts globaux de production et de traitement —

Partie 2: Lignes directrices relatives à l'application de la méthodologie et aux méthodes de calcul

Reference number
ISO 15663-2:2001(E)

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Printed in Switzerland

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this part of ISO 15663 may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 15663-2 was prepared by Technical Committee ISO/TC 67, *Materials, equipment and offshore structures for petroleum and natural gas industries*.

ISO 15663 consists of the following parts, under the general title *Petroleum and natural gas industries — Life-cycle costing*:

— *Part 1: Methodology*

— *Part 2: Guidance on application of methodology and calculation methods*

— *Part 3: Implementation guidelines*

Introduction

This part of ISO 15663 was developed in order to encourage the adoption of a common and consistent approach to life-cycle costing within the petroleum and natural gas industries. This will occur faster and more effectively if a common approach is agreed internationally.

This part of ISO 15663 has been prepared to provide guidance on the application of the methodology given in ISO 15663-1 [1] and on the calculations related to it.

It provides practical guidance towards the individual steps of the life-cycle costing process and aims to

— show how the potentials for added value can be achieved without life-cycle costing turning into a costly and time-consuming process;

— indicate how to structure the work within the process and define focus areas;

— transfer the experience of industry in applying the methodology, so that a common and consistent approach can be achieved.

It also promotes an understanding of the related methodologies and techniques and their application within the life-cycle costing framework.

Life-cycle costing is distinct from investment appraisal in that it is not concerned with determining the financial viability of a development. It is concerned only with determining the differences between competing options and establishing the options which best meet the owner's business objectives.

This part of ISO 15663 is based on the principles defined in IEC 60300-3-3, *Dependability management — Part 3: Application guide — Section 3: Life cycle costing*.

Petroleum and natural gas industries — Life-cycle costing —

Part 2: Guidance on application of methodology and calculation methods

1 Scope

This part of ISO 15663 provides guidance on application of the methodology for life-cycle costing for the development and operation of facilities for drilling, production and pipeline transportation within the petroleum and natural gas industries.

This part of ISO 15663 also provides guidance on the application and calculations of the life-cycle costing process defined in ISO 15663-1.[1]

This part of ISO 15663 is not concerned with determining the life-cycle cost of individual items of equipment, but rather with life-cycle costing in order to estimate the cost differences between competing project options.

2 Terms, definitions and abbreviated terms

For the purposes of this part of ISO 15663, the following terms, definitions and abbreviated terms apply.

2.1 Terms and definitions

2.1.1
initial investment
investment outlay for a project

NOTE Also known as CAPEX.

2.1.2
present value
value of the project cash flow excluding the initial investment outlay

2.1.3
life-cycle costing
process of evaluating the difference between the life-cycle costs of two or more alternative options

2.2 Abbreviated terms

CAPEX capital expenditure

FMECA failure mode effect and criticality analysis

FV future value

H,S&E health, safety and environment

IRR internal rate of return

NPV net present value

OPEX operating expenditure

OREDA® offshore reliability database

PI profitability index

PV present value

RAM reliability, availability and maintainability

RCM reliability-centred maintenance

TTE tools and test equipment

WACC weighted average capital cost

3 The process of life-cycle costing

3.1 The project focus

This subclause provides a guideline for the different steps of the methodology described in ISO 15663-1[1]. It should be recognized that the contribution of life-cycle costing to a project is no more or less important than that made by other support functions such as design, reliability or engineering.

Each of these functions provides its own unique perspective on the problem and each examines some aspects of performance. Life-cycle costing adds a long-term financial perspective and provides the means to

— predict financial performance through life on a quantitative basis,

— assess the financial implications of the contributions made by other functions,

— compare alternative options on a common financial basis.

Life-cycle costing cannot act in isolation and should interact with the other functions as part of the team approach.

3.2 Step 1 — Diagnosis and scope definition

3.2.1 Identify objectives

The objectives should be established through discussion with stakeholders and other members of the team, particularly the manager responsible for the overall work.

Two important aspects need to be established.

a) **What are we looking at?**

This provides the focus for the work and should establish what functions, systems or equipment are being examined.

b) **Why are we looking at it?**

This establishes the reason for the work.

These questions can be used to allow the user to relate the life-cycle costing work to the objectives.

Simple examples might be as follows.

EXAMPLE 1 **What** — a pumping system is being examined. **Why** — because the hydrocarbons need to be moved from one location to another.

The objective that life-cycle costing should address is the function of transferring the flow, and a pumping system may only be one of several options.

EXAMPLE 2 **What** — maintenance costs across the platform. **Why** — because maintenance is considered excessive or unless maintenance costs are reduced, production may be terminated early.

If a decision has already been taken to focus on maintenance and exclude other elements of OPEXs, this should be questioned. The objective of life-cycle costing is confirm the significant platform cost drivers and then assist in quantifying the opportunities for reducing costs.

EXAMPLE 3 **What** — gas compression. **Why** — there are gas reserves to exploit.

This is sufficient, the objective has been identified and a technical need already established for gas compression. This would lead into identification of the options available. The objective of life-cycle costing is to support the evaluation of alternative methods for compression.

EXAMPLE 4 **What** — a 20 MW power generation package. **Why —** a response should be made to a formal invitation to tender that includes life-cycle costing requirements.

The objective is not to provide a response to a tender, but to produce a winning bid, the discussion should now focus on how the bid team can use life-cycle costing to advantage.

In subsequent iterations of the process, this task may be limited to reconfirmation. However, it may be found that the life-cycle costing work changes the overall objective. Taking, as an example, maintenance cost optimization, the first iteration may show that downtime (lost production) is the cost driver, not maintenance costs.

3.2.2 Identification of constraints

The relevant constraints will arise from three principal sources as follows:

— **project constraints** on what can be achieved within the life-cycle costing work;

These will arise from resource and time scale limitations of the work. A typical example would be the need to change the contracted specification during construction and hook-up. This might require a response in a few days, or at least a couple of weeks. The life-cycle costing approach should be tailored to this time scale ("quick and dirty"). This may mean a go/no go response, i.e. either the change has little impact on life-cycle costs or it has a significant impact. Generally, where there is a constraint on either the time or resources available to undertake the work, the level of detail should be reduced and not the number of options considered.

— **technical constraints** which limit the options available;

EXAMPLE A change to an existing facility that requires additional equipment means there may be topside weight and space constraints on the options, or an operator may be constrained to certain technical options;

— **budgetary constraints**.

There may exist limitations on CAPEX or alternatively, the outcome may be subject to hurdle rates, e.g. an option must achieve an IRR of 10 % before it merits further consideration.

Constraints can be imposed by third parties or other external influences. Examples of such constraints are environment discharge or health and safety issues.

3.2.3 Establishment of decision criteria

3.2.3.1 General

For life-cycle costing within the oil and gas industry, the decision criteria selected should always reflect the corporate requirements of the end user, generally the operator. At a lower level, additional considerations may be associated with the contractor's or vendor's corporate objectives. In an alliance partnership, the criteria will need to be agreed by all partners.

In defining the decision criteria, reference should always be made to the originator or customer, both to establish the criteria and to ensure there is sufficient understanding as to how to apply them. The user's understanding is not simply limited to technical comprehension, but should also include an agreement as to how criteria should be used to select options.

3.2.3.2 Measure economic evaluation method

The measure that is selected should enable alignment of technical decisions with corporate objectives. It should therefore be a structured approach for defining the economic impact of technical decisions.

The most common measures are described in clause 4. These are:

— NPV;

— life-cycle cost;

— IRR;

— PI;

— the payback method;

— break-even;

— cost per standard barrel of oil.

The selection of measure depends on the item under consideration and on which phase or iteration the project has entered. For the first iterations of the life-cycle costing process, the object investigated is the field development itself or the development concept. The revenue stream in total can be dedicated to this object. All the traditional economic evaluation methods can therefore be applied.

For the further iterations, the concept is broken down into the individual systems and further into equipment units. For these iterations no particular part of the revenue can be related to the object under consideration. The measure of life-cycle cost can then be applied. Through minimizing the total life-cycle cost of an asset or a function, where impact on the revenue stream of failures occurring are taken into consideration as a cost, asset value can be maximized in a consistent manner.

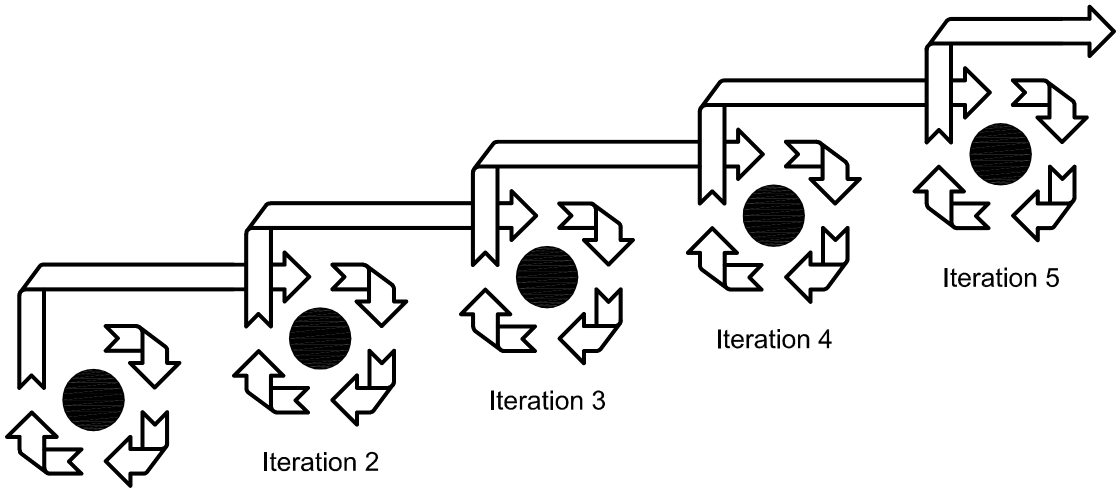
For these later iterations NPV and IRR can be applied when evaluating additional CAPEX resulting in reduced OPEX. The difference between the options of making the investment or not can then be considered as an investment appraisal evaluation.

An example of application of different measures or criteria is shown in Figure 1.

In the process of life-cycle costing, often only the difference between various options for filling a function can be evaluated. The possible measures that can be applied are then reduced to NPV or life-cycle cost, since the others listed are calculated from the total cost and revenue stream associated with the decision.

3.2.3.3 Assumptions

The assumptions that are set for calculations are vital for the evaluation of alternatives in order to determine which gives the highest added value. The most important assumptions are listed in Table 1. The areas to be aware of for calculations are addressed under 3.4.1.



	Iteration 1	Iteration 2	Iteration 3	Iteration 4	Iteration 5
Activity:	Field commerciality	Concept selection/ optimization	Outline design Process flow	Detail design	Procurement
System optimization					
Result:	Go/No go	Concept	Functions	Design alternative selection	Equipment
			Main equipment list	Material selection	
Criteria:	NPV/IRR/PI, etc.	NPV/IRR/PI, etc.	Life-cycle cost	Life-cycle cost	Life-cycle cost
	The traditional economic evaluation		Life-cycle cost		
The process of life cycle costing					

Figure 1 — Asset boundaries and evaluation of functional requirements

Table 1 — Assumptions

— Timing — Investment year — Start of operation — Life of field — Discount rate — Pre-tax / After-tax-calculations	How costs during operation are weighed against the initial investment	Which is the best system solution/equipment alternative?
— Output requirement over time — Cost of power	The impact of improving efficiency	
— Production profile — Criticality	The potential cost of failures	

3.2.4 Identify potential options

Options and sub-options for the function under review should be considered by a multidisciplinary team.

The use of a facilitator who can structure the meeting and log all options generated by the team can significantly improve the quality of the exercise. A well-proven technique to generate options and identify cost drivers is a functional/cost analysis of the investment. This technique is part of value engineering or functional value analysis workshops. Reference is made to clause 4. In function/cost analysis, a multidisciplinary team establishes the main functions of the investment and then establishes the sub-functions for the main functions. The equipment options for each sub-function are then identified and evaluated by the team. The evaluation of options will normally be in two stages: initial evaluation is carried out on a qualitative basis and some options may be evaluated from further study. Remaining options after the first screening are evaluated by undertaking life-cycle costing. Option generation and evaluation are normally carried out in distinct phases to ensure that evaluation does not inhibit the option generation process.

3.2.5 Establish options

Establishing the potential options implies screening the options arising from the previous task. The work can be carried out as the second half of the function/cost analysis, carried out in a full value engineering or functional value analysis workshop. This can save time and effort, and the ideas from the brainstorming are still fresh in people's minds.

The screening process should be applied consistently, in that each option should be subject to the same assessment criteria. A typical range of screening criteria may include the following questions:

— Is it technically feasible?

— Is it practical?

— Is it too expensive?

— Can it meet the programme?

— Can it meet the HS&E programme?

— Are the risks acceptable (technical, financial, revenue)?

— Is it consistent with corporate policy and is it acceptable to our partner?

— Can we evaluate it?

3.2.6 Define costs to be included in the analysis

To identify the cost elements related to an asset or a system, the function of the asset and the interrelations/dependencies toward the other systems should be evaluated.

Evaluation of operation can be in terms of what should be added to get the right output. This may include

— output requirements,

— power requirement,

— requirement of utilities/support systems,

— downstream effect of efficiency, resistance, etc.

Evaluation of maintenance can be in terms of what should be added to keep the process going. This may include

— regularity requirements for the system,

— maintenance concept/workload.

Revenue impact can be evaluated in terms of the consequence of failures.